REPORT ON THE CONSERVATION STATUS OF ARABIS FECUNDA, A CANDIDATE THREATENED SPECIES

Taxon Name:	Arabis fecunda Rollins
Common Name:	Sapphire rockcress
Family:	Brassicaceae (Cruciferae)
State where taxon occurs:	Montana, U.S.A.
Recommended federal status:	USFWS Category 2 (C2)
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Date of first report:	November 1985
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I. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: Arabis fecunda Rollins (Rollins 1984)

2. SYNONYMS: None

3. COMMON NAME: Sapphire rockcress

4. FAMILY: Brassicaceae (Mustard Family)

5. GENUS: Arabis contains more than 100 species of the Northern Hemisphere from desert to alpine habitats (Hitchcock et al. 1964).

6. SPECIES: Arabis fecunda was first collected by Jaculyn Cory at the type locality south of Charleys Gulch in mid-May, 1975 (Cory 1416 MONTU). These specimens were in flower, and she returned on 13 June 1976 to collect the type specimen (Cory 1611 MONTU) in fruit. The identification of these specimens remained undetermined until 1983 when they were sent to Reed C. Rollins at the Gray Herbarium of Harvard University who described the plant as a new species (Rollins 1984).

Type Specimen-- Ravalli County, Montana, on rocky terrain near sagebrush, big game range east of Corvallis, 13 June 1976, Jaculyn Cory 1611, MONTU. The type locality is one of the Charleys Gulch subpopulations, EO #001.

Cory's collections were large bolting specimens even though axillary flowering plants are much more common at the site (Walsh 1992, Lesica and Shelly 1994). Thus, Rollins' description of a "congested" inflorescence does not apply to axillary flowering plants. Furthermore, the petals fade to a purplish color described by Rollins, but are actually white in the field.

Rollins described A. fecunda as being closely related to A. fernaldiana (Rollins 1984).

B. PRESENT LEGAL OR FORMAL STATUS

1. FEDERAL STATUS

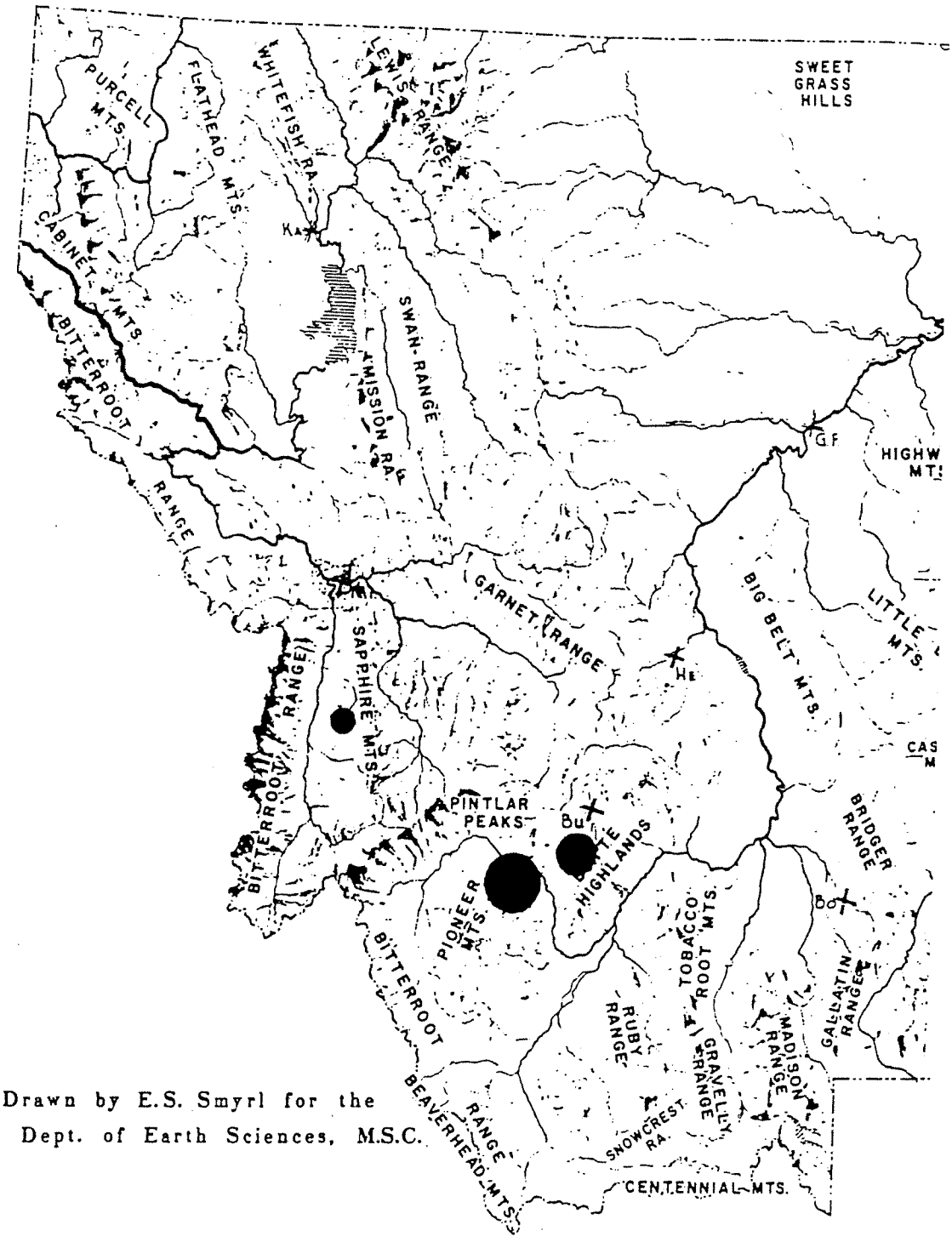
a. U.S. FISH AND WILDLIFE SERVICE: C2; Arabis fecunda is a candidate for listing as a

the rosette. Bolting inflorescences are generally larger and leafier than axillary inflorescences. An individual rosette may produce axillary inflorescences for numerous years, while bolting rosettes always die. Some rosettes produce axillary inflorescences for one to many years before either dying or bolting and then dying. Others bolt once and die. Axillary flower stalks are unbranched, while bolting inflorescences are often branched. Each flower has four white petals 0.25-0.5 in long and ca. 0.2 in wide. The flowers are close together on the stalk but become further apart as they mature into fruits. Fruits are 1-2 in long and ca. 0.05 in wide and held nearly erect by the stalks that may be up to 0.5 in long. The fruits are densely hairy, and each side of the fruit contains a single row of round seeds ca. 0.05 in diameter.

2. TECHNICAL DESCRIPTION: Perennial with a simple or branched caudex, densely pubescent throughout with fine dendritically branched trichomes; stems erect to somewhat decumbent at base, simple or few branched, 1-3 dm high; leaves hoary, dimorphic; basal leaves petiolate, spatulate to linear oblanceolate, entire or with a few broad teeth in the blade area, 1-3 cm long, 2-4 mm wide; cauline leaves sessile, entire or the lower with a few teeth, oblong, acute, sparingly auriculate to nonauriculate, 7-20 mm long; inflorescences usually congested, sepals oblong, nonsaccate, densely pubescent, 6-7 mm long, ca. 2 mm wide; petals purplish, obovate, not unguiculate, narrowing gradually from blade to point of insertion, 9-13 mm long, 3-5 mm wide; fruiting pedicels erect to slightly divaricately ascending, straight, 6-10 mm long; siliques erect, congested, usually appressed to rachis, straight to slightly curved inward, 3-5 cm long, ca. 1.5 mm wide, valves densely pubescent, compressed between seeds; styles ca. 1 mm long; seeds in a single row, suborbicular to slightly longer than broad, narrowly winged-margined all around, ca. 1.2 mm in diameter, mucilaginous when wetted; cotyledons accumbent (Rollins 1984)

It should be remembered that the above description was based on a very limited amount of material. An additional, more recent technical description can be found in Rollins (1993).

Figure 1. Location of Arabis fecunda populations.



Drawn by E.S. Smyrl for the
Dept. of Earth Sciences, M.S.C.

Table 1 (cont.)

009 SPRING GULCH II
Beaverhead Co., 454643N 1125354W, 5600 ft, T1S R11W S1
CA. 2.2 MILES EAST OF WISE RIVER, MT, ON HIGHWAY 43. AT BEND, 0.20 MILE SOUTH OF ROAD ATOP STEEP CLIFFS.

010 WISE RIVER
Silver Bow Co., 454708N 1125230W, 5600 ft, T1S R10W S5
T1N R10W S32
1.0 MILE WEST OF DEWEY, ON HIGHWAY 43; 0.33 MILE NORTH OF ROAD ON THE NORTH SIDE OF WISE RIVER.

011 CANYON CREEK
Beaverhead Co., 454101N 1125213W, 7000 ft, T2S R10W S8
PIONEER MOUNTAINS, CANYON CREEK AND VIPOND CREEK DRAINAGES, CA. 12 MILES WEST OF MELROSE, MT. ALONG CANYON CREEK ROAD (BEAVERHEAD N.F. RD. #187); ON SLOPES ABOVE OLD KILNS, AND ABOVE VIPOND CREEK.

012 LIME GULCH
Beaverhead Co., 452352N 1124844W, 6200 ft, T5S R10W S14
5 MILES WEST OF INTERSTATE-15, UP BIRCH CREEK ROAD. NORTH OF ROAD, ON EAST AND WEST FACES OF LIME GULCH.

013 CATTLE GULCH
Beaverhead Co., 454133N 1124712W, 6200 ft, T2S R10W S1
T1S R10W S36
PIONEER MOUNTAINS, CATTLE GULCH, 1.0-1.65 AIR MILES NORTHWEST OF CONFLUENCE OF CATTLE GULCH AND CANYON CREEK, CA. 7 AIR MILES NORTHWEST OF MELROSE, MT.

014 FISH CREEK
Silver Bow Co., 454807N 1122852W, 7080 ft, T1N R7W S28
HIGHLAND MOUNTAINS SOUTH OF BUTTE; FROM CAMP CREEK ROAD (FS RD 8520) TAKE ROAD TO FISH CREEK. ONCE ON THE FISH CREEK ROAD, PROCEED WEST UNTIL ROAD CROSSES TO SOUTH SIDE OF CREEK. PROCEED ANOTHER 0.3 MILES. SITE IS ON NORTH SIDE OF CREEK.

015 LIMEKILN HILL
Silver Bow Co., 454837N 1122747W, 7320 ft, T1N R7W S27
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM FISH CREEK ROAD (FS RD 668), TAKE ROAD TO LIMEKILN HILL (FS RD 8492). PROCEED 0.6 MILE; SITE IS ON RIDGE TO THE WEST.

016 TUCKER CREEK
Silver Bow Co., 454710N 1123951W, 6640ft, T1S R9W S1
T1N R9W S36
FROM DIVIDE (TOWN), TAKE FRONTAGE ROAD NORTH CA. 5 MILES. GO EAST UNDER I-15 TO RANCH, THEN TAKE ROAD TO RESERVOIR. SITE IS ON HILL NORTH OF RESERVOIR.

1. ASSOCIATED VEGETATION: Arabis fecunda generally occurs in relatively sparse vegetation. At three sites, bare soil varied from 40% to 80%, and basal vegetation varied from 20% to 50% (Lesica and Shelly 1994). Many of the sites occur on steep slopes with very sparse vegetation and periodic natural erosion. In some cases these steep slopes support cryptogamic soil crusts that have been shown to be beneficial to survival of A. fecunda plants (Lesica and Shelly 1992).

   In Ravalli County, zonal vegetation at A. fecunda sites is Artemisia tridentata-Festuca idahoensis-Agropyron spicatum steppe, sometimes with a sparse overstory of Pinus ponderosa. In Beaverhead and Silver Bow counties, associated vegetation is Cercocarpus ledifolius, Juniperus scopulorum or Pinus flexilis woodland, very open Pseudotsuga menziesii forest or sparse Agropyron spicatum grassland. Habitat descriptions and common associated species for the 18 sites are presented in Table 2.

2. PHYSIOGRAPHY: All known Arabis fecunda occur in the Northern Rocky Mountains of southwest Montana. Populations in the north part of the range are found in the west foothills of the Sapphire Range in the Willow Creek drainage, a tributary of the Bitterroot River. In the southern portion of the range A. fecunda occurs in the foothills and mountains at the north end of the East Pioneer Range and the Highland Mountains in the lower Big Hole River drainage. One population in the Highland Mountains is just across the divide in the drainage of the Jefferson River.

3. TOPOGRAPHY: Arabis fecunda usually occurs on moderate to steep slopes with a warm (SE, S, SW, W) aspect. Most sites are in lower slope positions, although populations do occur on mid and upper slopes. Elevations range from 4,700 ft to 7,800 ft; sites in Ravalli county are at or below 5,000 ft, while populations in the southern portion of the range are above 5,500 ft.

4. SOIL RELATIONSHIPS: Arabis fecunda occurs only on soils derived from calcareous sediments that have been metamorphosed to some extent by contact with granitic intrusions. Soils are generally sandy in texture with low organic matter content and a light albedo. Results of analysis of soil from the Charleys Gulch site in Ravalli county are

Table 2 (cont.)

011 CANYON CREEK
ON ROCKY CALC-SILICATE SLOPES, BENEATH PINUS FLEXILIS AND PSEUDOTSUGA MENZIESII, WITH ARTEMISIA TRIDENTATA, A. FRIGIDA, ERIGERON COMPOSITUS, CERCOCARPUS LEDIFOLIUS, AGROPYRON SPICATUM, PINUS CONTORTA AND POTENTILLA FRUTICOSA.

012 LIME GULCH
CALC-SILICATE ROCK OUTCROPS AND HILLSIDES, BENEATH JUNIPERUS SCOPULORUM, WITH CERCOCARPUS LEDIFOLIUS, SENECIO CANUS AND ERIGERON COMPOSITUS.

013 CATTLE GULCH
IN DRY, GRAVELLY CALCAREOUS SOILS ON STEEP SLOPES; CERCOCARPUS LEDIFOLIUS/AGROPYRON SPICATUM TYPE, WITH ARTEMISIA FRIGIDA, PHYSARIA GEYERI, LINUM PERENNE, SENECIO CANUS, GUTIERREZIA SAROTHRAE, CYMOPTERUS BIPINNATUS, OPUNTIA POLYACANTHA.

014 FISH CREEK
OPEN EXPOSURE ON STRAIGHT MIDSLOPE. DRY AREA, SANDY SOIL, CALCAREOUS METASEDIMENT. ASSOCIATED DOMINANT SPECIES: ARTEMISIA FRIGIDA, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED PLANT SPECIES: SENECIO CANUS, ERIGERON COMPOSITUS, CAMPANULA ROTUNDIFOLIA.

015 LIMEKILN HILL
OPEN EXPOSURE ON UNDULATING UPPER RESIDUAL MOUNTAIN SLOPE; DRY AREA, SILTY SOIL, CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: PINUS FLEXILIS, AGROPYRON SPICATUM, HAPLOPAPPUS ACAULIS. ADDITIONAL ASSOCIATED SPECIES: POTENTILLA FRUTICOSA, PENSTEMON ARIDUS.

016 TUCKER CREEK
OPEN EXPOSURE ON UNDULATING SLOPE, DRY AREA ON RESIDUAL MOUNTAIN MIDSLOPE. SANDY SOIL OF CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: CERCOCARPUS LEDIFOLIUS, AGROPYRON SPICATUM, HAPLOPAPPUS ACAULIS. ADDITIONAL ASSOCIATED SPECIES: ORYZOPSIS HYMENOIDES, CYMOPTERUS BIPINNATUS.

017 SOUTH FORK TUCKER CREEK
PARTIALLY SHADED EXPOSURE ON CONVEX SLOPE; DRY AREA ON RESIDUAL LOWER MOUNTAIN SLOPE. SANDY SOIL OF CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: CERCOCARPUS LEDIFOLIUS, JUNIPERUS SCOPULORUM, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED SPECIES: HAPLOPAPPUS ACAULIS, CYMOPTERUS BIPINNATUS. DEER SCAT PRESENT.

presented in Table 3. Sediments from Ravalli County belong to the Wallace Formation in the Precambrian Belt Series, while those from Beaverhead and Silver Bow counties are Paleozoic Madison limestone (Alt and Hyndman 1986).

5. REGIONAL CLIMATE: The closest weather recording station to the Ravalli County sites is at Hamilton, ca. 13 miles southwest and 1,000 ft lower. Mean temperatures for July and January are 67° and 25° F respectively, and mean annual precipitation is 13.1 in. The closest recording station to sites in Beaverhead County and most sites in Silver Bow County is Divide, at 5,406 ft along the Big Hole River. Mean temperatures for July and January are 63° and 19° F respectively, and mean annual precipitation is 12.4 in. Butte, at 5,540 ft, is ca. 13 miles north of three sites in Silver Bow County. Mean temperatures for July and January are 63° and 16° F respectively, and mean annual precipitation is 11.7 in (NOAA 1982). Many of the sites are appreciably higher than the recording stations, and thus likely experiences colder temperatures and greater precipitation.

6. DEPENDENCE ON ABIOTIC DYNAMICS: Periodic erosion and slumping of steep slope habitat may be partially responsible for maintaining the vegetation in a sparse condition, reducing competition for light, water and nutrients. These conditions may be important for the continued presence of A. fecunda at these sites. Many sites would be considered to be early successional or edaphic disclimaxes. Fire was relatively frequent in many of these areas, but the sparse vegetation present at the sites probably did not carry fire well.

   Lesica and Shelly (1993) found a strong positive correlation between winter precipitation and recruitment and survivorship. Thus, all else being equal, drier conditions are expected to result in population declines.

G. POPULATION DEMOGRAPHY AND BIOLOGY

1. PHENOLOGY: Seeds germinate readily without stratification (Lesica and Shelly 1994); thus, most seeds probably germinate in the fall. Observations of naturally occurring and garden plants suggest that vegetative growth occurs in early spring and perhaps again in fall if precipitation is adequate. At the Ravalli County

sites, Arabis fecunda begins flowering in early to mid-April, and mature fruit is present beginning in mid-May. Seed dispersal begins in late May. In Beaverhead and Silver Bow counties, flowering at the lower elevation sites occurs in mid-May through early June, and mature fruit can be found starting in early June. At sites near or above 7,000 ft, mature fruit can be found starting in mid-June. Flowering and fruit maturation depends on weather conditions in that year.

2. POPULATION SIZE AND CONDITION: Five of the known A. fecunda populations have fewer than 1,000 plants, seven populations have between 1,000 and 10,000 plants, and six have more than 10,000 plants. Population estimates for all known sites are given in Table 4. Most populations appear vigorous with plants of all sizes present.

3. REPRODUCTIVE BIOLOGY

   a. TYPE OF REPRODUCTION: Arabis fecunda reproduces from seed only. Seed is only produced following pollination (Walsh 1992), suggesting that agamospermy does not occur; however, pseudogamy cannot be ruled out.

   b. POLLINATION BIOLOGY: Walsh (1992) reports that Arabis fecunda is fully self-compatible. In nature, seed is probably a result of a combination of selfing and outcrossing. Results of an isozyme genetics study are consistent with a mixed mating system (Leeper et al., in press). It is not known what proportion of the seeds are the result of self-pollination.

      Pollinating agents of Arabis fecunda are not known. Plants flowers very early in the growing season; thus, the most likely pollinators are flies which are the only common vectors at that time of year. Mathew Hamilton (pers comm.) reported flies visiting A. fecunda flowers at Charleys Gulch in 1990.

   c. SEED BIOLOGY: In 1989-93 the number of seeds per fruit for Arabis fecunda at one site in Ravalli County and two sites in Beaverhead County varied between 5 and 56 with a five-year mean that varied between 31 and 34 (Lesica and Shelly 1994). Reproductive plants produced 0-96 fruits with a mean of 10.6-14.6 at the three sites (Lesica and Shelly 1994). Number of seeds and fruits

Table 4 (cont.)

017	SOUTH FORK TUCKER CREEK 10,000+ INDIVIDUALS
018	MOOSE TOWN 1000-5000 INDIVIDUALS, IN LARGEST SUBPOPULATION; ADDITIONAL SUBPOPULATION CA. 1.5 MILES NORTHWEST; 2000 PLANTS: THIRD SUBPOPULATION CA. 1 MILE NNW: 100-2000 STEMS.

Creek population (EO#008) had higher recruitment, faster growth, and higher mortality. Annual fecundity was higher and plants became fecund at an earlier age. Population size was more stable at Charleys Gulch than at Canyon Creek (Lesica and Shelly 1994). Walsh (1992) found that larger plants were more likely to survive and more likely to have higher reproductive rates.

The frequency of bolting was much higher at Canyon Creek, and this is likely the source of much of the difference between Arabis fecunda life histories at the two sites (Lesica and Shelly 1994). Bolting plants have higher annual fecundity and much higher mortality than axillary flowering plants. Axillary flowering plants are iteroparous (perennial or polycarpic), while bolting plants approach the semelparous (annual or monocarpic) life history (Lesica and Shelly 1994). Walsh (1992) also found that bolting plants are more likely to die.

e. POPULATION GENETICS: The differences in life history traits exhibited among the Arabis fecunda populations studied could be the result of genetic differentiation, phenotypic plasticity (one genotype that produces different phenotypes under different conditions) or both. Quantitative genetics studies are required to determine the basis of the variation. Leeper et al. (in press) used starch gel electrophoresis to investigate apportionment of genetic variation in Arabis fecunda populations. Of 18 putative loci scored, 17 were invariant; however, the one polymorphic locus had different frequencies among the populations, suggesting a degree of differentiation. Results of germination studies (Lesica and Shelly 1994) indicate that there is genetic differentiation between the Charleys Gulch and Canyon Creek populations. Furthermore, they suggest that there is a genetic difference between plants that bolt and those that do not. Together these results provide evidence that differences in life history traits between the two sites have a genetic basis (Lesica and Shelly 1994).

growth rate of A. fecunda, mainly by reducing recruitment (Lesica and Shelly, submitted). Hamilton and Mitchell-Olds (1990) found that the presence of C. maculosa reduced fecundity of A. fecunda at a Ravalli County site. Results of a study at Charleys Gulch and Birch Creek suggest that both species may be able to co-occur if the density of knapweed does not increase (Lesica and Shelly, submitted).

Competitive effects of other species on A. fecunda are not known.

2. FACILITATION: Cryptogamic soil crusts occur at some of the Arabis fecunda sites, and Lesica and Shelly (1992) demonstrated that soil crust benefits A. fecunda populations by increasing survival of adult plants.

   Although there is evidence that cattle have an adverse effect on A. fecunda populations (see below), under some conditions, they may be beneficial. Arabis fecunda establishes best when not in competition with other plants (Lesica and Shelly, submitted), so grazing of competitors may be advantageous. Exclosure studies at two sites near the Big Hole River suggest that grazing may sometimes have detrimental effects (Lesica 1993). At one site A. fecunda increased in the grazing exclosure, while at the other it decreased relative to controls. Furthermore. Some of the largest populations, such as Birch Creek and Jerry Creek, are in areas that are intensely grazed.

3. HERBIVORY: J. S. Shelly observed insect larvae in the fruits of Arabis fecunda at both Lime Gulch and Charleys Gulch in 1990. The identification of this insect is not known. Seed predation appears to be of limited extent.

   Scattered plants have been observed at Lime Gulch and Canyon Creek with the upper portion of one or two fruits bitten off (Lesica and Shelly, pers. observation). The source of this predation is not known.

4. PATHOGENS: A rust, Puccinia sp. was observed infecting a small number of plants at Charleys Gulch in 1985 (Lesica, pers. observation). Rust infections appear to be rare and local.

Table 5. Management responsibility for sites supporting populations of Arabis fecunda.

001	CHARLEYS GULCH PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE); STATE LAND - UNDESIGNATED
002	SPRING GULCH PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
003	ROCK QUARRY GULCH PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
004	BIRCH CREEK BLUFFS STATE LAND - UNDESIGNATED; PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
005	QUARTZ HILL BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
006	MOUTH OF QUARTZ HILL GULCH BLM: BUTTE DISTRICT, DILLON RESOURCE AREA; BEAVERHEAD NATIONAL FOREST, WISE
007	JERRY CREEK BLM: BUTTE DISTRICT, HEADWATERS RESOURCE AREA; STATE LAND - UNDESIGNATED
008	UPPER QUARTZ HILL GULCH BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
009	SPRING GULCH II BLM: BUTTE DISTRICT, DILLON RESOURCE AREA
010	WISE RIVER BLM: BUTTE DISTRICT, HEADWATERS RESOURCE AREA; PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
011	CANYON CREEK BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
012	LIME GULCH BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
013	CATTLE GULCH BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
014	FISH CREEK DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
015	LIMEKILN HILL DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

J. MANAGEMENT PRACTICES

1. MINING: Contact zones between granitic intrusions and Madison limestone are often areas of commercial mineral deposits (Alt and Hyndman 1986). This is the same geologic situation that provides the habitat for Arabis fecunda. Nine of fourteen sites in the southern portion of the range are in close proximity to old mines. However, Fish Creek is the only site with an active mine nearby. It is not known how past or present activity has affected A. fecunda populations

2. LIVESTOCK GRAZING: All known populations of Arabis fecunda except Spring Gulch II are subject to cattle grazing. Grazing is light in some areas such as Lime Gulch, Cattle Gulch and Canyon Creek, but heavy in others such as Birch Creek and Jerry Creek. Livestock are important vectors for exotic weed infestations. Effects of livestock grazing are discussed under Facilitation (G.2) and Other Negative Interactions (G.5) above.

3. RECREATION: All sites on public land managed by federal agencies are open to hunting. Portions of the Tucker Creek and South Fork Tucker Creek sites are in or near the boundaries of the Humbug Spires wilderness study area. None of the sites show evidence of off-road vehicle use. The effects of recreation on A. fecunda populations are not known but are probably negligible.

K. EVIDENCE OF THREATS TO SURVIVAL

1. EXOTIC WEED ENCROACHMENT: Centaurea maculosa is present at all known Arabis fecunda sites in Ravalli County. At most sites the infestations are severe. This aggressive exotic has been shown to have adverse effects on many native species including A. fecunda (Lesica and Shelly, submitted). Currently C. maculosa does not occur at any of the Beaverhead or Silver Bow county A. fecunda sites, but it does occur in these counties and could become a problem in the near future.

2. LIVESTOCK GRAZING: Livestock grazing occurs at most Arabis fecunda sites, although heavy grazing is reported for fewer than half the sites. Evidence for negative effects of livestock on A. fecunda are equivocal. Direct herbivory has never been observed and is probably rare. However,

A. GENERAL ASSESSMENT OF VIGOR, TRENDS AND STATUS: The geographic range of Arabis fecunda consists of two disjunct areas: (1) the northern area along the west face of the Sapphire Range in Ravalli County and (2) the southern area in the East Pioneer and Highland ranges in Beaverhead and Silver Bow counties. The status and trends of Arabis fecunda in these two areas appears to be different.

There are 14 known populations in the southern area, and many of these are large and relatively undisturbed. Weed infestations have not yet become a problem. Mining activity is a potential but not a current threat. Livestock grazing does occur at most sites, but evidence that it is a serious threat is unconvincing at this time. Monitoring studies suggest that populations are stable or perhaps even growing. Consequently, Arabis fecunda appears to be secure in the southern portion of its range.

There are four known populations in Ravalli County, two of which are quite large. All sites have been historically overgrazed, and invasion and serious degradation of native habitats by Centaurea maculosa occurs throughout the entire area. The area is experiencing increasing pressure from human population growth, so introduced weeds will likely be an escalating problem. Livestock grazing will likely continue into the foreseeable future. Results of monitoring studies suggest that populations in Ravalli County may be declining and that increased density of C. maculosa could lead to extirpation of populations. It seems likely that A. fecunda population viability in this area is trending downward.

The two areas are separated by ca. 80 miles, and the habitats Arabis fecunda occupies are noticeably different. Thus, there are likely to be genetically distinct populations in the two areas, and the little evidence available is consistent with this hypothesis. Although the majority of known populations are not currently threatened or endangered, Arabis fecunda may be threatened in a potentially significant portion of its range.

B. RECOMMENDED STATUS:

1. U.S. FISH AND WILDLIFE SERVICE: The distribution and size of Arabis fecunda populations are reasonably well known. However, threats and the significance of potentially threatened populations to the viability of the species as a whole are not

Disturbances from mining activities could be detrimental to A. fecunda populations. Any proposed mining activity in the area of populations should be reviewed and disturbances curtailed or mitigated.

In order to determine whether Arabis fecunda deserves status as a threatened or endangered species, it is essential to know the extent of genetic differentiation between threatened populations in Ravalli County and the unthreatened populations in Beaverhead and Silver Bow counties. This information is critical for developing a management plan for A. fecunda. Isozyme studies failed to answer this question (Leeper et al., in press). Genetic studies employing more powerful nuclear DNA methods should be used to determine the genetic distances among selected populations throughout the range of the species. Furthermore, quantitative genetics studies to determine the degree of differentiation for traits that may be under strong local selection should be conducted.

D. INTERESTED PARTIES

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III. INFORMATION SOURCES

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